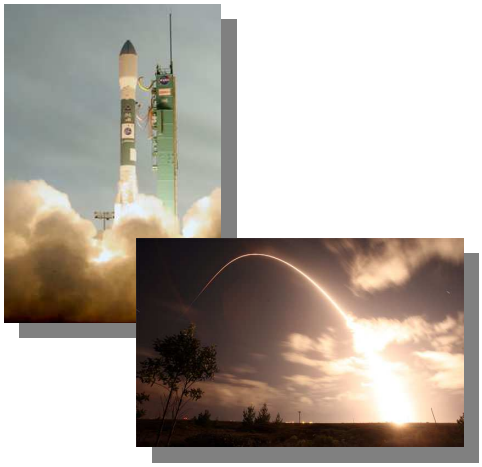
PRIMA
Core Spacecraft

PRIMA (***P**iattaforma **R**iconfigurabile **I**taliana **M**ulti **A**pplicativa*) is a high adaptability multimission Core Spacecraft which can be configured to support a variety of payloads and can be utilized for different classes of LEO and MEO missions. PRIMA is based upon state of art space technology, a modular architecture and an Integrated Control System.

Main Features

: *PRIMA* is a 3 axis stabilized Bus, with Sun and Stars Sensors and a set of 4 Reaction Wheels and 3 Torquerods as actuators, with steering capabilities on each axis, ***high pointing accuracy (<0.01°)*** and ***knowledge (<0.003°), real time orbit determination (<10 m)*** and propulsion system for orbit control (130 kg).
It is provided with Mil-1553 command bus as computer, avionic and satellite communication back-bone and ERC 32 processor architecture. Its architecture is based on three modules structurally and functionally decoupled to allow parallel integration and testing



PRIMA Core Spacecraft Mission Heritage

- 4 Satellites have completed in flight acceptance and are fully operational (Radarsat-2,COSMO-SkyMed FM-1,FM-2 and FM-3)
- 5 Satellites in the pipeline (COSMO-SkyMED FM-4 ,ESA GMES Sentinel-1 A, ESA GMES Sentinel-1 B, ESA GMES Sentinel-3 A, ESA GMES Sentinel-3 B)
- 2 Satellites COSMO Second Generation are under contract evaluation.

- **A total of 10 years accumulated flight hours**
- **Flight Proven Mission Availability (e.g. RADARSAT-2 >99,8%)**

Launch Vehicle Compatibility and Orbit Capability

Launch Vehicle Compatibility:

Soyuz, Zenit, Ariane 5, Delta II, EuRockot, Dnepr, PSLV, Cosmos, Taurus,Falcon-9, DeltaII

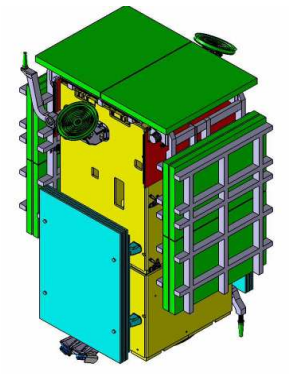
Parameter	LEO Satellite Orbits
Orbit Type	LEO, Sun Synchronous
Local time Ascending Node	6:00 and 18:00 with possibility of different LTAN
Altitude	450 to 1500 km Environment limits outside indicated boundaries
Inclination	From 0° to SSO inclination Also depending on the selected Launch Vehicle
Lifetime	7 years
Reliability	0.9 @ 7 y

PRIMA SubSystems Architecture Overview

	Item	PRIMA	Note
POWER	Solar Array	4200 W	3800 W @ Winter Solstice
	Avg. Power to P/L (in one orbit)	1100 W	
	Peak Power	>14 kW	For significant percentage of the orbit, function of selected battery
	Battery	330Ah	Li-ion or Ni-H2
	Solar Arrays	>18 m2	Max values limited by Launcher Fairing

Thermal Control: the system uses primarily passive techniques (paints, doublers, fillers, insulation gaskets, SSM and MLI) to meet the applicable requirements. Other components of the subsystems are:

- constant conductance heat pipes
- electrical heaters
- thermistors
- thermostats



	Item	PRIMA	Note
Mechanical	Core S/C Mass	≤1100 kg	Estimated configuration values. Minimum configuration does not include optional S/S
	Core S/C Height	3300 mm	Max values appendages are limited by Launcher Fairing
	P/L Mass	<1200 kg	Reference values
	Primary Structure Material(s)		Honeycomb, with CFRP facesheets (for internal items) and Al facesheets (for external panels)
	Physical Dimensions	1344x1344x3300 mm	

	Item	PRIMA	Note
TT&C	Downlink	16 - 512 kbps	Rate Selectable. S-band or X band
PDHT (Payload data Handling & Transmission)	Downlink Formats	CCSDS	
	Mass Memory	300 Gbit	Steerable up to 2400 Gbit
	X-band TX	310 Mb/s	2 channels at 155 Mb/s

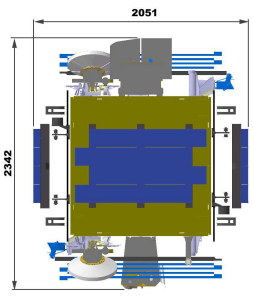
AOCS: 3-axes stabilized architecture which assures the pointing performances

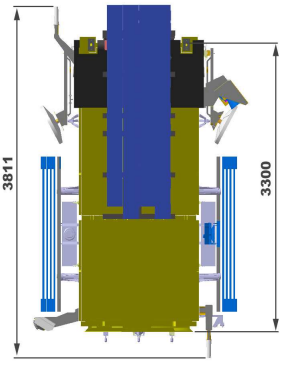
Pointing Knowledge	< 18 arcsec
Pointing Control	< 36 arcsec
Pointing Stability (Jitter)	< 1 arcsec/sec
Slewrate	up to 1°/sec

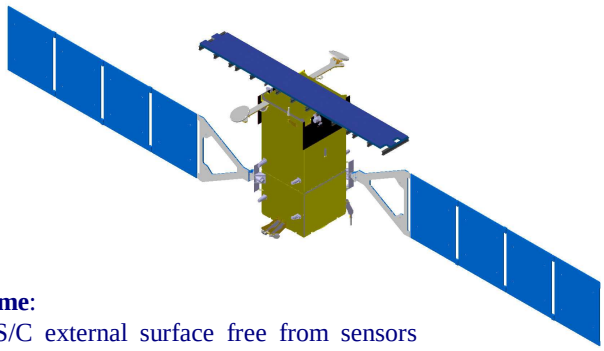
Command & Data Handling
Bus Architecture: Mil-Std-1553B

	Item	PRIMA
Propulsion	Type/Architecture	Monopropellant system operating in blow down mode
	Propellant Type	Hydrazine
	Pressurant Type	Helium gas
	Maximum Propellant Load	134.2 (Tank capacity = 176 lt)
	6 Thrusters	

Flight and stowed-for-launch configurations







P/L Available Volume:

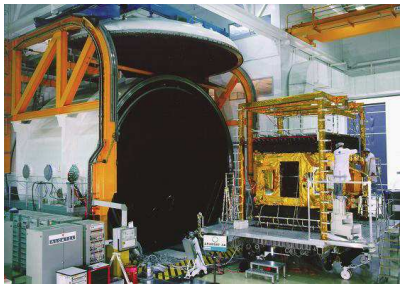
- **External**: S/C external surface free from sensors and appendixes, compliant with launcher fairing envelope
- **Internal**: 1 P/L Module Panel

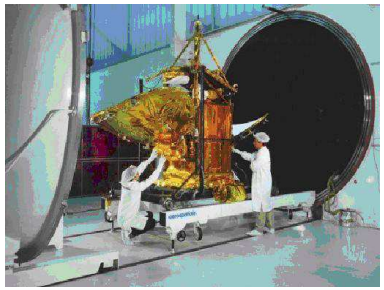
Test facilities

Test facilities located in both Rome (Italy) and Cannes (France) address all the environmental test activities related to space products

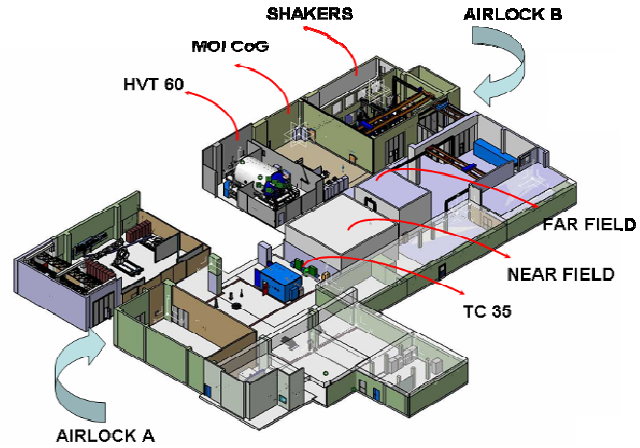
- **Mechanical tests : Vibration, shocks, MOI CoG and Acoustics**
- **Radiated test: Anechoic Chamber**
- **Deployment test: Solar Array facility**
- **Thermal tests: Thermal Chamber, Thermal Vacuum Chamber and Vacuum Chamber**

Thermal Vacuum Chambers





Cleanroom and Test facilities layout



Baseline Delivery Schedule

S/C Requirements Review (SRR)
ARO+3

S/C Preliminary Design Review (PDR)
ARO+6

S/C Critical Design Review (CDR)
ARO+12

Core Spacecraft Integration & Test

Instrument Integration Readiness Review(IIRR)
ARO+26

Observatory Pre-Environmental Review 1 (PER-1)
ARO+29

Observatory Pre-Shipment Review (PSR)
ARO+36

Observatory Acceptance Review (OAR)
ARO+42

Observatory Integration

Observatory Test

Storage & Transportation Activities

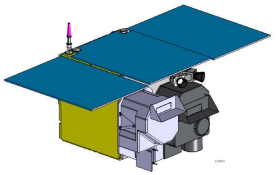
Launch Site Integration & Test Activities

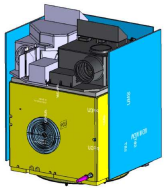
Commissioning & In-Orbit Support

PRIMA-S Option

has a light and compact configuration design, characterized by the absence of a dedicated external payload module and provided with payload dedicated panels. The design is directly derived from PRIMA heritage.

Parameter	PRIMA-S
▪ Core Spacecraft dry mass ▪ Loadable propellant	≤ 340 kg 55 ÷ 130kg
▪ Max payload mass ▪ Max payload power ▪ Power SA (BOL)	≤ 450 kg ≤ 500 W average 600 W ÷ 2000 W
Data processing capability	≤ 17 Mips
Observatory agility	60° slew ≤ 60 s
▪ Pointing accuracy ▪ Pointing knowledge ▪ Pointing stability	≤ 0.01° ≤ 0.003° ≤ 1 arcsec/s
Observatory localisation	10 m (3σ)
Lifetime	7 ÷ 10 years
Core Spacecraft Reliability	~ 0.9 @ 7 y





Advanced Data Handling

The advantages of PDHT High Rate architecture, derived from ESA Sentinel-1 PDHT configuration, are to optimize the redundancy parts (DSHA single box and four TWTA) to ensure better reliability, provide a large amount of storage memory and improved data rate both in input and output. Performance are summarized in the table

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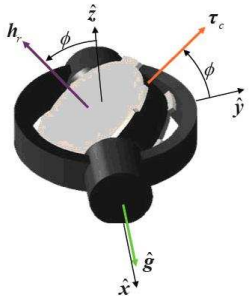
Requirements	Specified Figure
Input Data I/F	Up to 1280Mbps
Mass Memory Area	1410Gbits EOL
Operating Frequencies	L1 Channel: 8105 MHz ± 72.5 MHz L2 Channel: 8260 MHz ± 72.5 MHz
Modulation & Coding	4D-TCM 2.5b/Hz 8PSK
Transmitted Symbol Rate	112 MSps per channel
Useful Downlink Data Rate	260 Mbps per channel
Command & Control	1553B bus (PUS Standard)
Total Mass	60Kg
Maximum Power Consumption	400 Watts

High Agility Add-on

Control Moment Gyro actuators (CMG) can be mounted on the PRIMA Core Spacecraft (in both configuration, PRIMA and PRIMA-S) to provide very large torque capability.

Respect to reaction wheels, CMG mechanisms are more efficient in terms of produced torque, whose value can be compared to the one of thrusters, without having their typical disadvantages.

CMG can provide enhanced agility performance up to 10 times the PRIMA and PRIMA-S presented performance.



Rapid Spacecraft Development Office (RSDO)
NASA Goddard Space Flight Center
Mail Code 401.1
Greenbelt, MD 20771 USA
Phone: 301-286-1289
Email to: rsdo@rsdo.gsfc.nasa.gov